SUPERFUND BENEFITS ANALYSIS

PARTIAL DRAFT – PREPARED EXCLUSIVELY FOR REVIEW BY THE EPA SCIENCE ADVISORY BOARD'S SUPERFUND BENEFITS ANALYSIS ADVISORY PANEL

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Acronyms and Abbreviations

ACLs	Alternate Concentration Limits
AM	Action Memorandum
ARARs	applicable or relevant and appropriate requirements
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
ATSDR	Agency for Toxic Substances and Disease Registry
BPb	blood lead
BLL	blood lead level
BLRA	baseline risk assessment
C&I	commercial and industrial
CAG	Community Advisory Group
CCD	construction complete or deleted
CEPP	Chemical Emergency Preparedness Program
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CI	confidence interval
CLU-IN	Hazardous Waste Clean-up Information Website
CNS	central nervous system defects
COI	cost of illness
CVM	contingent valuation method
CWA	Clean Water Act
DNAPL	dense non-aqueous phase liquid
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior
EECA	Engineering Evaluation/Cost Analysis
EPA	United States Environmental Protection Agency
EPA ReachIt	Remediation and Characterization Technology Database
EPCRA	Emergency Planning and Community Right-to-Know Act
ERT	Superfund Environmental Response Team
ESD	Explanation of Significant Differences
ETV	Environmental Technology Verification Program
FY	fiscal year
GIS	geographic information system
GSI	Ground Water/Surface Water Interface Criteria
HazDat	Hazardous Substance Release/Health Effects Database
HC	Health Consultation
HPM	hedonic property model
HRS	Hazard Ranking System
HSEES	Hazardous Substances Emergency Events Surveillance Database
ICs	institutional controls
IEUBK	Integrated Exposure Uptake Biokinetic model
LA	Linear Absolute model

LP	Linear Percentage model
LULU	locally undesirable land use
MEI	maximally exposed individual
mg/kg	milligrams per kilogram
MSA	Metropolitan Statistical Area
µg/dL	microgram per deciliter
MUS	musculoskeletal system defects
NCEE	National Center for Environmental Economics
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFRAP	No Further Remedial Action Planned
NIEHS	National Institutes of Environmental Health Sciences
NLA	Non-Linear Absolute model
NLP	Non-Linear Percentage model
NOAA	National Oceanic and Atmospheric Association
NPL	National Priorities List
NRC	National Research Council
NRD	natural resource damages
NRDA	natural resource damage assessment
NTD	neural tube defect
O&M	operations and maintenance
OIRA	Office of Information and Regulatory Affairs
OMB	Office of Management and Budget
OR	odds ratio
ORD	Office of Research and Development
OSC	On-Scene Coordinator
OSWER	Office of Solid Waste and Emergency Response
OTA	Office of Technology Assessment
OU	Operable Unit
PA	preliminary assessment
Pb-B	blood lead
PBT	persistent bioaccumulative and toxic
PCBs	polychlorinated biphenyls
PHA	public health assessment
PPM	property-based pricing method
PRP	potentially responsible party
PV	present value
RA	remedial action
RCC	Resource Conservation Challenge
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RI/FS	remedial investigation/feasibility study
ROD	Record of Decision
RSE	Removal Site Evaluation
RSEI	Risk-Screening Environmental Indicators Model
RTDF	Remediation Technologies Development Forum
RTU	Return to Use Initiative

SAB	Science Advisory Board
SACM	Superfund Accelerated Cleanup Model
SARA	Superfund Amendments and Reauthorization Act
SBA	Superfund Benefits Analysis
SBRP	Superfund Basic Research Program
SFIP	Sector Facility Indexing Project
SI	site inspection
SITE	Superfund Innovative Technology Evaluation Program
SOD	single-family, owner-occupied, detached home
SuperJTI	Superfund Job Training Initiative
SVOCs	semi-volatile organic compounds
TAG	Technical Assistance Grant
TCE	trichloroethylene
TOSC	Technical Outreach Services to Communities
TRI	Toxics Release Inventory
USDA	United States Department of Agriculture
UST	Underground Storage Tank
VCP	Voluntary Cleanup Program
VOC	volatile organic compound
WTA	willingness to accept compensation
WTP	willingness to pay

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EXECUTIVE SUMMARY

Following increased public awareness in the 1970s of the national problem of abandoned hazardous wastes, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) in 1980 and the Superfund Amendments and Reauthorization Act (SARA) in 1986. These bills were signed by Presidents Carter and Reagan and form the basis of the Superfund program. Together, these and related laws established a federal program for preventing, mitigating, and responding to releases of hazardous substances that might threaten human health and the environment. Six major approaches to the problem are taken under Superfund, as seen in Figure ES.1 and defined in Table ES.1.

Figure ES.1 and Table ES.1 also show nine benefit categories, divided into fundamental and embedded categories. The fundamental benefit categories are those found in the EPA's *Guidelines for Conducting Economic Analyses* (Exhibit 7-1, p. 67), and are the most basic reasons for the Superfund program: to mitigate human and ecological health risks, to improve other amenities, and to reverse environmental damage to materials. In many cases, these benefits are generated directly. However, there are other important outcomes, that are labeled embedded because they are direct objectives of the Superfund program and would likely be ignored if only the fundamental benefit categories were considered. Of course, the embedded benefit categories are valued largely because they lead *in*directly to the fundamental benefits (or to lower costs). Since it is not possible to quantify any future fundamental benefits, the distinction between fundamental and embedded benefit categories is a response to difficulties in measurement. In the current study, only fundamental benefits are quantified, so no issue of double counting arises.

Figure ES.1. Approaches Taken Under Superfund, and Resulting Benefit Categories

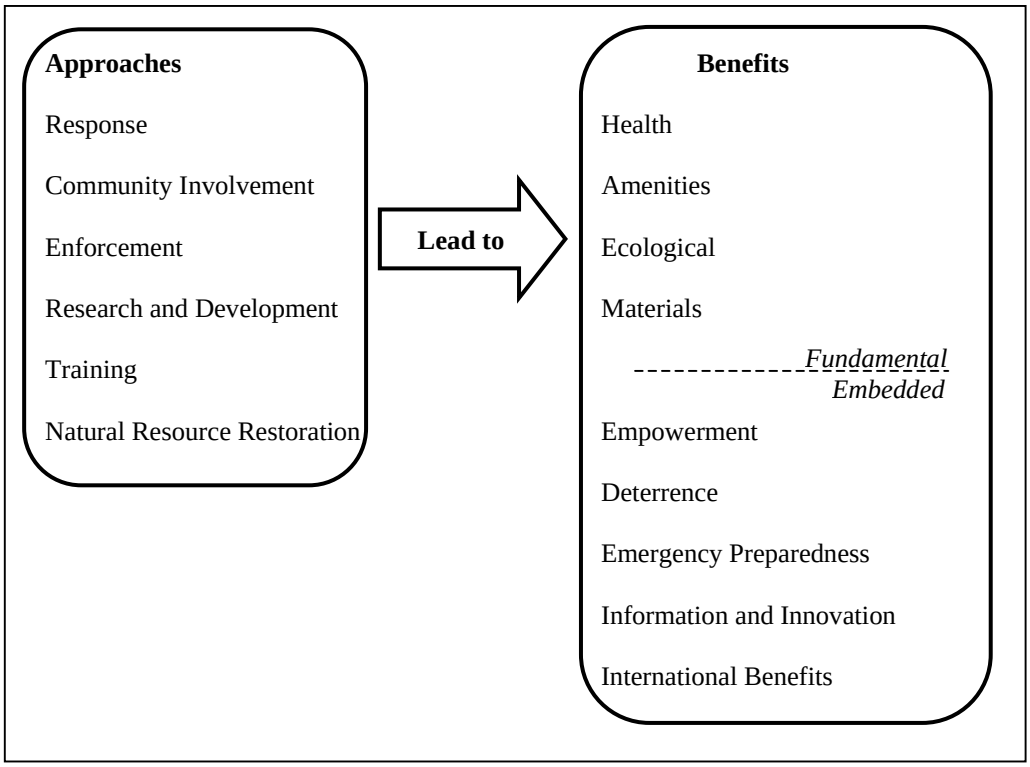


Table ES.1. Categories of Benefits of Superfund

Benefit	Definition
Fundamental	
Health	Actions taken to improve human health, which may include reducing the magnitude of exposure to contaminants, reducing the number of exposure pathways, reducing the length of exposure, and providing information so that individuals can reduce their exposure or seek medical treatment.
Amenities	Any feature of a place, object, or experience that enhances its attractiveness and increases the user's satisfaction, but is not essential to the place, object, or experience. In the context of Superfund, amenities include the removal of unsightly structures, the reuse of abandoned property, the avoidance of the stigma associated with contamination, and the reduction of perceived health risk from uncontrolled releases of hazardous substances.
Ecological	The restoration and maintenance of service flows to both humans and nature from natural resources, such as land, ground water, and habitat. These services may include recreation, clean water, shelter, food, timber, and others.
Materials	The reduction of risk and perceived risk associated with non-residential (i.e., commercial and industrial) properties, and the ensuing ability and willingness of the business and financial community to use these properties.
Embedded	
Empowerment	The ability of people who live near Superfund sites (especially NPL sites) to learn about the site(s) of interest, have questions about the site(s) answered, participate in decision-making associated with the site(s), and hold the relevant organizations accountable.
Deterrence	Incentives for firms and individuals that may create or use hazardous substances to handle and dispose of them properly and to avoid uncontrolled releases to the environment.
Emergency Preparedness	The knowledge, skills, organization, and technologies necessary to limit harm to human health and the environment following disasters involving the release of hazardous substances. Includes preparation for natural disasters, homeland security measures, and similar activities.
Information and Innovation	Increases in knowledge and technical capabilities created as a result of research, development, and deployment supported by the Superfund program. This includes both basic scientific research as well as efforts to develop and build experience and confidence in new technologies.
International Benefits	Any benefits from any of the other benefit categories that accrue to people or organizations outside of the United States. These benefits are generally coordinated with the State Department and often involve overseas response actions or training.

The Superfund program includes the following elements: enforcement authorities to negotiate or order response actions; a federal trust fund to pay for response to releases; and cost recovery authorities allowing the federal government to sue for costs of response actions under joint, strict, and several liability provisions. The Superfund program supports communities that are burdened with hazardous substance sites by providing them with a better understanding of, and opportunities to participate in decisions regarding the sites. The Superfund program supports a program for developing and deploying knowledge and technologies to better manage hazardous substances. This work provides a foundation for much of the current understanding and management of hazardous substances. The Superfund program provides training for thousands of first responders (fire fighters, police, emergency room nurses, etc.) so they can protect the public and themselves by detecting and identifying hazardous substances. This training provides essential elements of the homeland security capabilities of the United States. The Superfund

program has enabled the restoration of hundreds of streams, rivers, wetlands, and other places. Finally, the Superfund program has created powerful incentives for industry innovation to reduce the creation of hazardous waste, reduce the need for hazardous substances, and manage hazardous substances responsibly.

For the first time, the current study addresses the full range of Superfund benefits with the question: ***What are the benefits of Superfund for the period 1980-2004?*** To do so, this study *enumerates* the benefits of Superfund and *describes* each one, *quantifies* those benefits for which the appropriate data and methods are available, and *monetizes* benefits when possible.

For the purposes of this study, the Superfund program includes all the provisions of and programs created by, or attributable to, CERCLA and SARA. Due to data and methodological limitations, almost all of the quantification of benefits is associated with sites on the National Priorities List (NPL), although there is evidence that this biases the quantitative estimates of the benefits of Superfund downward by a non-trivial amount.

Results and Discussion

This study develops three partial and slightly overlapping estimates of the monetary value of the benefits of the Superfund program.[1] Each estimate uses a benefits transfer approach of some variety.

Many of the benefits of the Superfund program derive from response actions, which include, but are not limited to, remedial actions at sites on the NPL. For most people, it is the NPL alone that characterizes Superfund. However, removal actions are also important, as are state response actions. Figure ES.2 illustrates the total number of response actions attributable to Superfund for the period 1980-2004. This figure shows all federal response actions and 25% of state response actions as reported by 33 states, based on a rough estimate of the fraction of state budgets for response actions that is derived from federal sources. This approach ignores any role that Superfund has in encouraging private firms to participate in state-run voluntary cleanup programs or any other forms of federal support for state programs (e.g., training, research, and so forth).

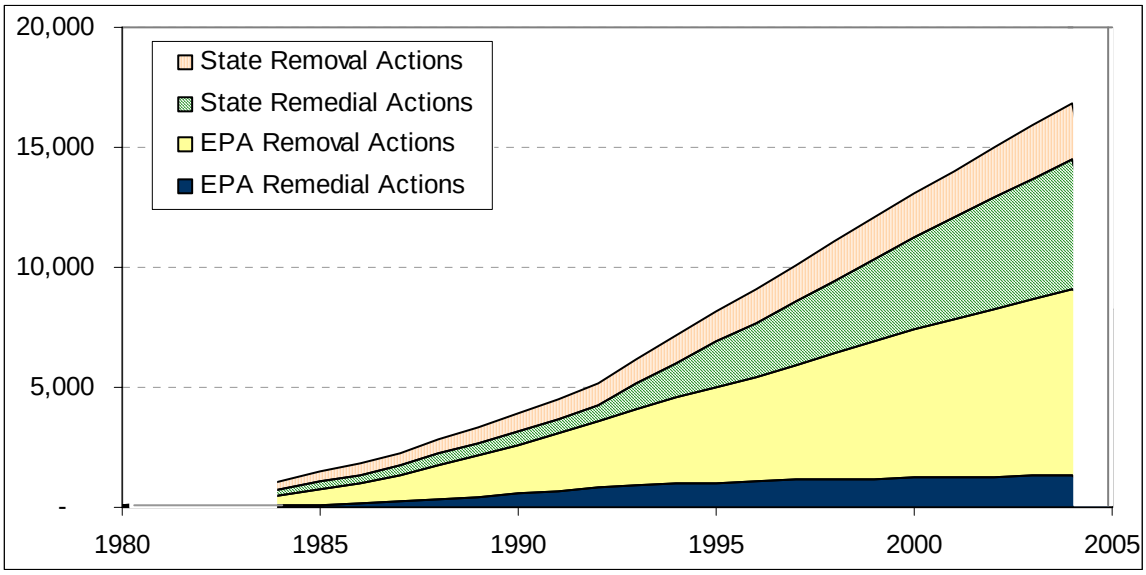
Importantly, these values do *not* address the risk addressed by any of these response actions; they only address the number of actions. There are no reliable data on the risk mitigation of removals or of state response actions, but there is some anecdotal evidence that at least some of these responses mitigate significant risks.

Based on these calculations, Superfund is responsible for slightly less than 17,000 response actions for the period 1980-2004, of which remedial actions at NPL sites make up less than 10%.

[1] The current version of this study is incomplete. By agreement with the EPA Science Advisory Board's Environmental Economics Advisory Committee, the analyses in Chapter 5 are not completed, only described. The agreed-upon process is for EPA to provide a description of the data and proposed methodology and submit a completed analysis based on input received from the Advisory Panel on the intended approach.

Figure ES.2 illustrates these results. States report very large numbers of sites "in need of attention," suggesting that this level of effort could continue for some time.

Figure ES.2. Total Superfund Responses

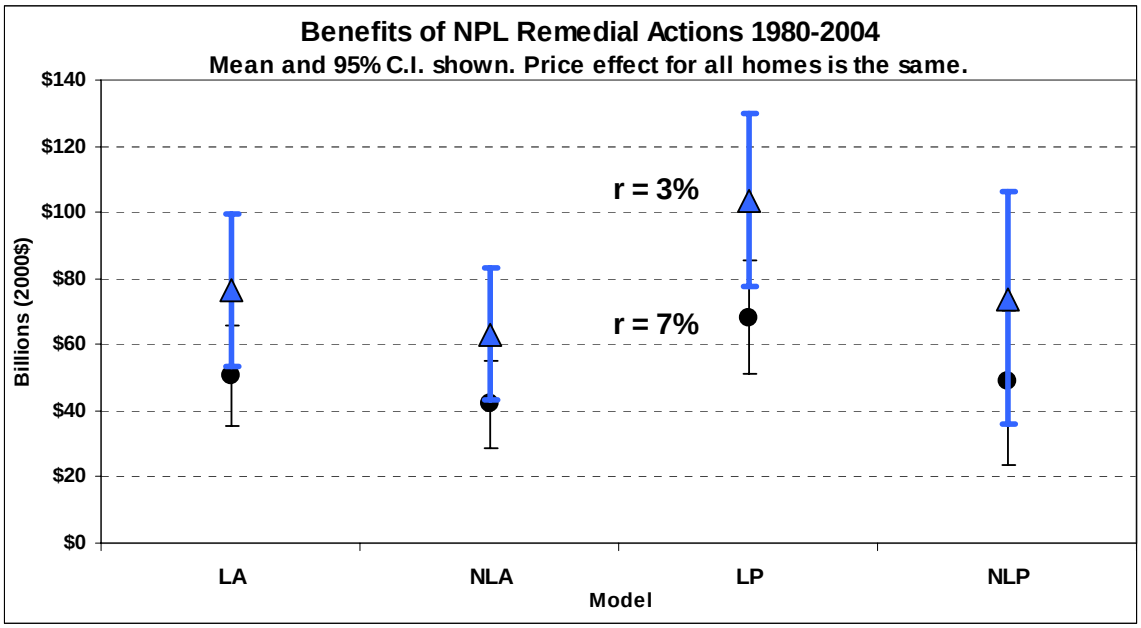


Chapter 4 presents an analysis that captures part or all of several benefits. It is a benefits transfer analysis of results from nine studies that have been published in the peer-reviewed literature that use market data about residential property sales.[2] This study performs a meta-analysis of the prior research, and applies the results in a benefits transfer analysis to all those NPL sites where remedial action occurred during the period 1980-2004. The meta-analysis indicates that homes within 2.5 miles of an NPL site experience a 7.4% decline in value at the time the site is discovered, or about $10,000, and that for most sites this decline is reversed after definitive plans for remedial action have been made. The negative price effect is non-linear, so homes closer to the NPL site boundary suffer a greater effect. The benefits transfer analysis yields a partial estimate of benefits; it excludes benefits not likely to be reflected in home prices (e.g., ecological values) and benefits created by other actions attributable to Superfund (e.g., health risk reductions due to removal actions, or increased preparedness to respond to certain emergencies due to Superfund-sponsored research and training). Four different models are used for the benefits transfer analysis.

The mean estimates of the benefits measured by the four models range from $63-$100 billion over the period 1980-2004 (using a 3% discount rate). The 95% confidence intervals range from a low of $41 billion to a high of $130 billion. The best point estimate of the present value (1980, r=3% in year 2000$) of the benefits of NPL remedial actions for the first 25 years of the Superfund program appears to be about $63 billion. These results (for discount rates of both 3% and 7%) are shown in Figure ES.3. Converting these total estimates into annualized values yields an estimate of $3.6-$5.9 billion per year, assuming a 3% discount rate, with a best point estimate of $3.6 billion per year.

[2] The technical name for the approach these studies take is the hedonic price method.

Figure ES.4. Present Value of the Benefits of NPL Site Remedial Activities, 1980-2004
(Billion 2000$, Base year 1980, 2.5 miles)



Note: Only a portion of the total benefits of Superfund is captured in these estimates. See text.

Chapter 5 contains descriptions of several effect-by-effect approaches that are proposed to estimate some of the health and ecological benefits of Superfund. These approaches are designed to avoid problems associated with risk-based data that have been proposed for use in similar benefits estimates in the past. The basic approach to the health effects is to estimate the number of cases of various negative health outcomes that will be avoided using either epidemiological or integrated exposure uptake biokinetic models, and a cost of illness approach to valuing these avoided health outcomes. For ecological benefits, the proposed approach is to use information from natural resource damage assessments to illuminate the type and magnitude of ecological benefits created by Superfund. Monetary values for a fraction of these benefits can be obtained, but adequate data do not appear to be available to quantify or monetize the ecological benefits of response actions at this time. Finally, several possible approaches to quantify the benefits of protection and cleanup of groundwater are proposed, along with one to monetize these benefits. However, none of these analyses is completed in the current draft of this study. Once this analysis is completed, these benefits cannot be added to the benefits estimated in Chapter 4 due to possible double counting.

Chapter 6 contains a detailed description of a number of benefits that cannot be quantified at this time.

The report concludes with a short summary and suggestions for future research that would aid in the regulation and management of hazardous substances.

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